AK

(12) UK Patent Application (19) GB (11) 2 111 530 A

(21) Application No 8136888
(22) Date of filing 8 Dec 1981
(43) Application published 6 Jul 1983
(51) INT CL[3] C25D 5/02 C23F 1/08 C25D 5/08 C25F 3/00 7/00
(52) Domestic classification C7B 120 152 154 209 268 327 722 AL B6J MG2 U1S 2066 B6J C7B
(56) Documents cited
GB A 2075898
GB A 2066718
GB A 2064398
GB A 1521130
GB 1270971
GB 1061840
GB 1060753
(58) Field of search
C7B
C7E
C7F
(71) Applicant
Standard Telephones and Cables Limited, (Great Britain), 190 Strand, London, WC2R 1DU
(72) Inventor
Miles Patrick Drake
(74) Agent and/or address for service, M. C. Dennis, ITT UK Patent Department, Maidstone Road, Footscray, Sidcup, DA14 5HT

(54) Selective electro plating or etching process

(57) High speed electrolytic plating or etching of a metal surface is effected by directing a jet of electrolyte on to the region to be treated and irradiating the region with high frequency ultrasound. This promotes rapid exchange of the electrolyte at the metal surface.

GB 2 111 530 A

2111530

1/1

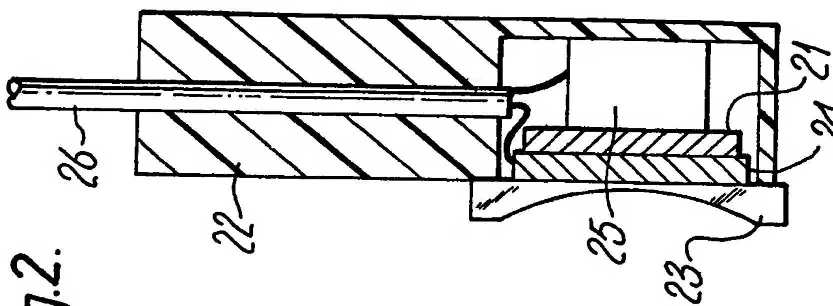

Fig.2.

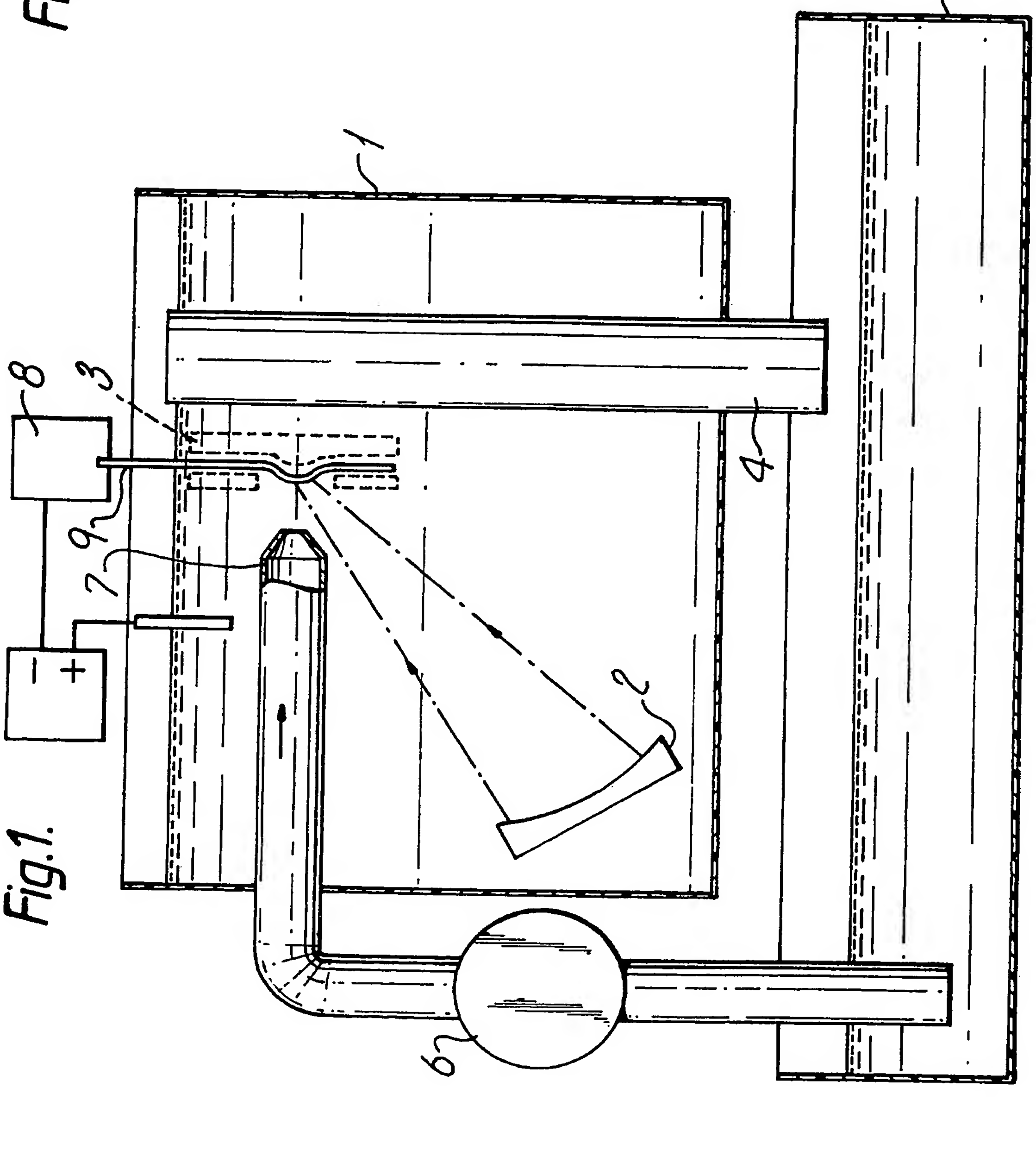

Fig.1.

SPECIFICATION
Selective plating process

This invention relates to electrolytic processes, and in particular to plating processes wherein deposition of the plated material is enhanced by the application of sonic energy.

One published specification No. 1 521 130 (M. P. Drake 3) describes a process for the selective enhancement of the transport rate of ions across a metal/electrolyte boundary during an electro-machining electroplating or etching operation, which process includes irradiating at least a portion of the boundary with a locally intense field of sonic waves at ultrasonic frequency, said irradiation locally agitating the electrolyte, the frequency of said irradiation being sufficiently high to ensure that substantially no cavitation of the electrolyte is produced.

In that arrangement focussed ultrasonic energy was used to provide an enhanced deposition rate over the irradiated region. After the plating step the deposited material could be restricted to the irradiated area by electrolytic removal of some of the deposit such that the thinner (non-irradiated) regions were reduced to zero thickness. The process could be used e.g. in the selective gold plating of electrical contacts.

Whilst this and similar processes are effective in producing high quality plated deposits they are limited in processing speed by the rate at which ions of the depositing metal can be transported through the solution to the deposition region.

According to one aspect of the present invention there is provided a method of selective electroplating, chemical deposition or etching of a metal surface from solution wherein a combination of jet agitation and ultrasound agitation are used to promote fast exchange of solution at the surface.

According to another aspect of the invention there is provided an apparatus for selective electrolytic deposition or etching of material to or from a metal surface, said apparatus including a container for receiving a quantity of plating or etching solution, means for applying an electric potential between the solution and the metal surface, means for directing a jet of the solution against a region of the surface, and means for ultrasonically agitating said region so as to promote fast exchange of the solution at the surface.

We have found that by diverting a stream of the electrolyte towards the deposition region a considerable enhancement in the deposition rate without loss of the quality of the plated deposit can be effected.

Advantages of such systems include the reduction of pumping power in high speed electrochemical systems and improvement in deposit quality.

It is believed that the ultrasound agitates the solution in close proximity to the electrode while jet agitation exchanges solution between the bulk of the solution and a layer to the surface. The combination of the two thus efficiently exchanges ions between the cathode surface and the bulk of the solution.

An embodiment of the invention will now be described with reference to the accompanying drawings in which:—

Fig. 1 is a schematic view of a selective plating apparatus;

and Fig. 2 is a sectional view of one form of ultrasonic transducer for use in the apparatus of Fig. 1.

Referring to Fig. 1 the selective plating apparatus is contained in a tank 1 which may be part of a continuous reel-to-reel processing line for a plating process. The parts 9 to be plated are carried on a moving belt 8 which supplies the cathodic connection.

The transducer assembly 2 is mounted so as to provide an intense region of ultrasound saturation along the length of the selective plating tank and in the desired region of the workpiece. The transducer is provided with means, e.g. a dielectric lens 23 (Fig. 2), for focussing the sound energy produced. Further provision may be made to ensure accurate definition of the plated region of the work piece for example by the use of conformal masks 3 well known in such processes.

The tank 1 has an outlet 4 leading to a storage tank 5 from which electrolyte is supplied by a pump 6 to a multiplicity of jet nozzles 7 mounted in the tank and directed towards the focal point of the transducer 2 so as to impinge directly on the plated area of the workpiece along the whole tank length.

In a further embodiment (not shown), the transducer assembly may employ a titanium lens for ultrasound concentration which can also act as the anode for the plating process and support the jet nozzle.

To effect plating the transducer is energised from a high frequency power supply (not shown), typically 0.5 to 2 MHz so as to produce an intense energy field at the transducer focus. At the same time the pump is switched on to divert a jet of electrolyte into the sonic energy field. The work-pieces 19 to be selectively plated are brought into or traversed through the energy field where they are exposed to a combination of ultrasonic energy, fluid flow and electroplating current. The ultrasonic energy provides cavitation-free local agitation of the electrolyte and the fluid jet prevents depletion of the electrolyte in the region of the workpiece surface by continuously supplying fresh material. It is thought that the focussed ultrasound agitates the electrolyte in close proximity to the work-piece surface while jet agitation exchanges electrolyte between the bulk of the solution and a layer near the work-piece surface. The combination of the two effects effectively exchanges ions between the work-piece (cathode) surface and the bulk of the solution thus providing for the rapid deposition of high quality electroplated material.

Using such a technique we have found that the electroplated material is deposited preferentially

on the irradiated region of the work-piece which has the length of ultrasound irradiation and jet solution flow. This feature renders the process particularly suitable for the selective deposition of precious metals, e.g. gold, over a limited area only of a contact element thus resulting in a considerable cost saving compared with conventional plating processes.

As an example, using the system shown in Fig. 1, it was found that, with jet agitation alone, the electrodeposit formed on test coupons first became cracked at a plating current density of 40 Adm^{-2} and was covered with cracks and nodules at 60 Adm^{-2}. With ultrasound irradiation along, cracks formed at 10 Adm^{-2}.

With both ultrasound and jet agitation cracks did not appear until 60 Adm^{-2}, a gain of 20 Adm^{-2} on the jetting alone. The technique of ultrasonic irradiation may thus be used either to increase the plating or to improve the quality of the gold deposit.

A typical ultrasonic transducer assembly is shown in Fig. 2. The piezo-electric transducer element 21 is mounted in a housing 22 and is acoustically coupled to a dielectric, e.g. polymethylmethyacrylate, lens 23 via an aluminium bar 24. The bar 24 provides both an impedance transformer and a front contact for the transducer element 21. The back contact to the transducer element is provided by a leaf spring 25. Electrical power is supplied to the arrangement via a coaxial cable 26. It will be noted that the lens 23 is concave to provide a focussing effect in aqueous solution.

It will of course be appreciated that the techniques described herein are not limited to the use of the transducer construction shown in Fig. 2 and that alternative constructions may be employed.

In some applications the techniques described herein can be employed to plate preferentially a region of a workpiece. Subsequent etching or deplating can then be employed to remove a predetermined plating thickness so as to leave only the thicker deposit in the preferred region.

Claims

1. A method of selective electroplating, electroetching, chemical deposition or etching of a metal surface from solution wherein a combination of jet agitation and ultrasound agitation are used to promote fast exchange of solution at the surface.

2. A method as claimed in claim 1, wherein said solution is a gold electroplating solution.

3. A method as claimed in claim 2, wherein said metal surface comprises an electrical contact.

4. A method as claimed in claim 3, and which includes subsequent non-selective partial deplating, of the metal surface.

5. A method as claimed in any one of claims 1 to 4, wherein said ultrasound agitation is provided by an ultrasonic transducer immersed in the solution.

6. A method as claimed in claim 5, wherein said ultrasound is focussed on a selected region of the metal surface.

7. A method of selective deposition or etching on to or from a metal surface, said method being substantially as described herein with reference to the accompanying drawings.

8. An electrical connector provided with contacts treated by a method as claimed in any one of claims 3 to 7.

9. An apparatus for selective electrolytic deposition or etching of material to or from a metal surface, said apparatus including a container for receiving a quantity of a plating or etching solution, means for applying an electric potential between the solution and the metal surface, means for directing a jet of the solution against a region of the surface, and means for ultrasonically agitating said region so as to promote fast exchange of the solution at the surface.

10. A selective deposition or etching apparatus substantially as described herein with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1983. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained